REMARKS

In response to the rejection under 35 U.S.C. § 112, second paragraph, and under 35 U.S.C. § 101, claim 23 has been amended to set forth positive, manipulative steps for the claimed process. Withdrawal of the foregoing rejection is respectfully requested.

Claims 1 and 23 have also been amended to limit the content of the specific ether compound to within the range of 75 to 97 mass % (support in Table 1 at page 14 of the specification) and to limit the water content to 5 mass % or less (support at page 9, lines 29-32 of the specification).

Review and reconsideration on the merits are requested.

Claims 1-5, 12-13, 15 and 23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 6,200,891 to Jagannathan et al. Jagannathan et al. was cited as teaching an etching solution and etching method substantially as claimed, the etching solution comprising HF, an ether compound (i.e., diglyme) and preferably not containing water.

In the "Response to Argument" at pages 9-10 of the Office Action, the Examiner further cited Jagannathan et al as disclosing an etching solution containing about 5 M of a fluoride-containing compound (e.g., HF) and an organic solvent for selectively removing dielectric oxide (col. 2, lines 30-32), where the organic solvent may be diglyme (col. 4, line 33). Because the etching solution of Jagannathan et al preferably does not contain water (less than 3%), the Examiner calculated that an etching solution having 5 M HF in diglyme has 20-25 wt% HF and 75-80 wt% of the ether.

Applicants traverse, and respectfully request the Examiner to reconsider in view of the amendment to the claims, the test data presented in the Declaration under 37 C.F.R. § 1.132 of Daisuke Watanabe dated February 19, 2008 submitted herewith and the following remarks.

1. Explanation of the Present Invention:

The etching solution of the present invention is characterized as containing a specific ether compound. Further, the respective contents of the ether compound, HF and water are controlled at a specific ratio. More particularly, the present invention is directed to an etching solution and etching method using the etching solution in which "the ratio of HF to the specific ether compound to water is 3 mass % or greater, 75 to 97 mass %, and 5 mass % or less." As demonstrated in the Rule 132 Declaration submitted herewith, the etching solution of the present invention provides remarkable effects and specifically an etching rate ratio (THOX/HfSiO) of 1.0 or less.

As described in the Rule 132 Declaration, etching solutions for evaluation were prepared having the composition as set forth in Table 1 of the Declaration. Particularly, while holding the HF content at 20 mass %, the monoglyme content and water content were varied from 80 mass % to 0 mass % and 0 mass % to 80 mass %, respectively. Etching rates and etching selectivity of each solution thus prepared were measured for test substrates comprising, on a silicon substrate, (1) a hafnium oxide silicate film formed by MOCVD and annealed (MOCVD HfSiO Anneal), and (2) a thermal oxide (THOX) film, respectively. The results are set forth in Table 1 of the Declaration and reproduced below.

Table 1

	HF (mass%)	Monoglyme (mass%)	Water concent-ration (mass%)	Etching temperature (°C)	Etching rate (Å/minutes)		Etching rate ratio (THOX/HfSiO)
					MOCVD HfSiO Anneal	THOX	
Ex. A	20%	80%	0%	23	9	2	0.22
Ex. B	20%	75%	5%	23	22	23	1.0
Com. Ex. C	20%	69%	11%	23	26	112	4
Com. Ex. D	20%	60%	20%	23	30	277	9
Com. Ex. E	20%	50%	30%	23	32	510	15
Com. Ex. F	20%	30%	50%	23	33	1100	26
Com. Ex. G	20%	10%	70%	23	34	1600	43
Com. Ex. H	20%	0%	80%	23	35	2000	57

As demonstrated in the test data presented in the Declaration, the etching solutions of Examples A and B of the invention having an ether content of 75 mass % or 80 % and a water content of 5 mass % or less provided an etching rate ratio (THOX/HfSiO) of 1.0 or less, whereas Comparative Example C containing the same ether compound but in a slightly lower content of 69 mass % and water in an amount of 11 mass % resulted in an etching rate ratio of 4. The etching rate ratios of Comparative Examples D to H in which the ether content was further reduced and the water content was increased resulted in even much higher etching rate ratios. More specifically, in accordance with the invention, by formulating the etching solution to have an ether compound content of 75 to 97 mass % and a water content of 5 mass % or less, the present invention provides an etching rate ratio (THOX/HfSiO) of 1.0 or less which Applicants submit is surprising and unexpectedly superior over the prior art relied upon by the Examiner. Moreover, the test data presented in the Declaration establishes that the claimed ether content of

75 to 97 mass % and the claimed water content of 5 mass % or less is critical to achieving the effects of the invention not disclosed or suggested by the prior art. Namely, as shown in the Declaration, the etching solution of the invention can etch a high H-K film, while greatly suppressing the silicon oxide film etching rate.

2. Response to Rejection over Prior Art:

In the "Response to Argument" the Examiner states:

> "... Therefore it is clear that a solution with molarity of 5 for HF in diglyme, has 20-25% HF by weight which is more than 3% claimed HF and 80-75% of ether which is in the claimed range for ether compound and 0% of water (less than 3o). Therefore, Jagannathan teaches a solvent which is in the range of claimed by the applicant and therefore claim 1 is not patentable. ..."

However, Jagannathan et al. does not specifically teach the content of the solvent (ether compound). In particular, such a very high concentration, i.e., 75% or more, is not clearly described.

In the "Response to Argument," the Examiner calculated the content of the ether compound on the assumption that the etching solution of Jagannathan et al. comprises only HF and an ether compound (solvent).

However, the etching solution of Jagannathan is not based on the assumption that the etching solution consists of only two components which are HF and an ether compound (solvent). Rather, the etching solution contains a third component in addition to HF and an ether compound.

For example, Example 1 of Jagannathan et al. discloses that acetic acid or the like is contained in addition to HF and a solvent (propylene carbonate).

As is clear from the above, it is not appropriate to calculate the content of the ether compound (solvent) based on the assumption that the etching solution of Jagannathan et al. contains only HF and an ether compound.

For the same reasons, Applicants respectfully dispute that the content of the solvent (an ether compound such as diglyme) in the etching solution of Jagannathan et al. is 75 to 80 mass %. Therefore, Jagannathan et al. does not teach or suggest an ether compound content of 75 to 97 mass % as required by the amended claims.

Moreover, Jagannathan et al. did not recognize that when the ratio of HF to a specific ether compound to water is 3 mass% or greater: 75 to 97 mass%: 5 mass% or less, excellent etching effects such as an etch rate ratio (THOX/HfSiO) of 1.0 or less is obtained.

The above-noted effect of the present invention could not have been predicted in advance based on Jagannathan et al., and Jagannathan et al. in any event fails to disclose an etching solution containing a specific ether compound in an amount of 75 to 97 mass % as required by the amended claims. For the above reasons, it is respectfully submitted that the amended claims are patentable over Jagannathan et al., and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Claims 14 and 16 were rejected under 35 U.S.C. §103(a) as being unpatentable over Jagannathan et al. in view of U.S. Patent 5,120,605 to Zuel et al. Zuel et al. was cited as teaching an etching solution for oxide surfaces containing HF and ether, diethylene glycol, diethyl ether and diethylene glycol monomethyl ether.

Claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Jagannathan et al. and U.S. Patent 4,469,525 to Dodge. Dodge was cited as disclosing an etching solution for etching oxides such as concrete, comprising a strong mineral acid such as HF and a solvent such as cellosolve acetate within the scope of claim 17.

Claim 18 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Jagannathan et al. and U.S. Patent Publication No. 2003/0160026 A1 to Klein et al. Klein et al. was cited as teaching an etching medium comprising ethylene glycol monobutyl ether and HF for etching oxide surfaces.

Claim 21 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Jagannathan et al. and U.S. Patent Publication No. 2003/0235985 to Christenson et al. Christenson et al. was cited as disclosing a process for etching high dielectric constant films more rapidly than coexisting SiO_2, polysilicon, etc., films using an etching solution containing HF.

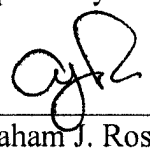
Applicants rely on the response above with respect to the rejection of claims 1-5, 12-13, 15 and 23 over Jagannathan et al. cited as a primary reference. Further, the amendment to the claims limiting the water content to an amount of 5 mass % or less distinguishes over Christenson et al. which employs water as an essential solvent.

Withdrawal of all rejections and allowance of claims 1-5 and 12-18, 21 and 23 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: March 6, 2008